

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.**

Japanese Patent Laid-Open Publication No. Heisei 9-8205

[TITLE OF THE INVENTION]

RESIN-ENCAPSULATED SEMICONDUCTOR DEVICE

5

[CLAIMS]

1. A resin-encapsulated semiconductor device using
a lead frame which is shaped in accordance with a two-step
etching process to a body wherein a thickness of inner
10 leads is less than that of the lead frame blank,
comprising:

inner leads having the thickness less than that of the
lead frame blank; and

15 terminal columns integrally connected to the inner
leads and having the same thickness with the lead frame
blank, the terminal columns possessing a column-shaped
configuration which is adapted to be electrically connected
to an external circuit, the terminal columns being disposed
20 outside of the inner leads in a manner such that they are
coupled to the inner leads in a direction orthogonal to the
thickness-wise direction thereof, the terminal columns
having terminal portions arranged on top ends thereof, the
terminal portions being made of solders, etc. and exposed
25 to the outside beyond a resin encapsulate, each inner lead
possessing a rectangular cross-section and having four

surfaces including a first surface, a second surface, a third surface and a fourth surface, the first surface being flushed with one surface of a remaining portion of the inner lead having the same thickness with the lead frame blank while being opposed to the second surface, and each of the third and fourth surfaces having a concave shape depressed toward the inside of the inner lead.

2. A resin-encapsulated semiconductor device using a lead frame which is shaped in accordance with a two-step etching process to a body wherein a thickness of inner leads is less than that of the lead frame blank, comprising:

inner leads having the thickness less than that of the lead frame blank; and
terminal columns integrally connected to the inner leads and having the same thickness with the lead frame blank, the terminal columns possessing a column-shaped configuration which is adapted to be electrically connected to an external circuit, the terminal columns being disposed outside of the inner leads in a manner such that they are coupled to the inner leads in a direction orthogonal to the thickness-wise direction thereof, portions of top ends of the terminal columns being exposed to the outside beyond a resin encapsulate, each inner lead possessing a rectangular

cross-section and having four surfaces including a first surface, a second surface, a third surface and a fourth surface, the first surface being flush with one surface of a remaining portion of the inner lead having the same thickness with the lead frame blank while being opposed to the second surface, and each of the third and fourth surfaces having a concave shape depressed toward the inside of the inner lead.

10 3. The resin-encapsulated semiconductor device as claimed in claims 1 or 2, wherein a semiconductor chip is received inward of the inner leads, and electrodes of the semiconductor chip are electrically connected to the inner leads through wires, respectively.

15 4. The resin-encapsulated semiconductor device as claimed in claim 3, wherein the lead frame has a die pad, and the semiconductor chip is mounted onto the die pad.

20 5. The resin-encapsulated semiconductor device as claimed in claim 3, wherein the lead frame does not have a die pad, and the semiconductor chip is fastened to the inner leads using a reinforcing fastener tape.

25 6. The resin-encapsulated semiconductor device as

claimed in claims 1 or 2, wherein the semiconductor chip is
fastened by means of insulating adhesive to the second
surfaces of the inner leads on one surface thereof on which
the electrodes are located, and the electrodes of the
5 semiconductor chip are electrically connected to the first
surfaces of the inner leads through wires, respectively.

7. The resin-encapsulated semiconductor device as
claimed in claims 1 or 2, wherein the semiconductor chip is
10 fastened to the second surfaces of the inner leads by bumps
thereby to be electrically connected to the inner leads.

[DETAILED DESCRIPTION OF THE INVENTION]

[FIELD OF THE INVENTION]

15 The present invention relates to a resin-
encapsulated semiconductor device capable of meeting the
requirement for an increase in the number of terminals and
resolving problems which are caused in association with
position shift and coplanarity of an outer lead.

20

[DESCRIPTION OF THE PRIOR ART]

FIG. 15(a) shows the configuration of a generally
known resin-encapsulated semiconductor device (a plastic
lead frame package). The shown resin-encapsulated
25 semiconductor device includes a die pad 1511 having a

semiconductor chip 1520 mounted thereon, outer leads 1513
to be electrically connected to the associated circuits,
inner leads 1512 formed integrally with the outer leads
1513, bonding wires 1530 for electrically connecting the
tips of the inner leads 1512 to the bonding pad 1521 of the
semiconductor chip 1520, and a resin 1540 encapsulating the
semiconductor chip 1520 to protect the semiconductor chip
1520 from external stresses and contaminants. This resin-
encapsulated semiconductor device, after mounting the
semiconductor chip 1520 on the bonding pad 1521, is
manufactured by encapsulating the semiconductor chip 1520
with the resin. In this resin-encapsulated semiconductor
device, the number of the inner leads 1512 is equal to that
of the bonding pads 1521 of the semiconductor chip 1520.
And, FIG. 15(b) shows the configuration of a monolayer lead
frame used as an assembly member of the resin-encapsulated
semiconductor device shown in FIG. 15a. Such a lead frame
includes the bonding pad 1511 for mounting the
semiconductor chip, the inner leads 1512 to be electrically
connected to the semiconductor chip, the outer lead 1513
which is integral with the inner leads 1512 and is to be
electrically connected to the associated circuits. This
also includes dam bars 1514 serving as a dam when
encapsulating the semiconductor chip with the resin, and a
frame 1515 serving to support the entire lead frame 1510.

Such a lead frame is formed from a highly conductive metal such as a cobalt, 42 alloy (a 42% Ni-Fe alloy), copper-cased alloy by a pressing working process or an etching process. FIG. 15(b)(D) is a cross-sectional view taken along the line F1-F2 of FIG. 15(b)(1).

Recently, there has been growing demand for the miniaturization and reduction in thickness of resin-encapsulated semiconductor device employing lead frames like the lead frame (plastic lead frame package) and the increase of the number of terminals of resin-encapsulated semiconductor package as electronic apparatuses are miniaturized progressively and the degree of the integration of semiconductor device increase progressively. Thus, recent resin-encapsulated semiconductor package, particularly quad plate package (QFPs) and thin quad flat packages (TQFPs) have each a greatly increased number of pins.

Lead frames having inner leads arranged at small pitches among lead frames for semiconductor packages are fabricated by a photolithographic etching process, while lead frames having inner leads arranged at comparatively large pitches among lead frames for semiconductor packages are fabricated by press working. However, lead frames having a large number of fine inner leads to be used for forming semiconductor packages having a large number of

pins are fabricated by subjecting a blank of a thickness on the order of 0.25 mm to an etching process, not a press working.

5 The etching process for forming a lead frame having fine inner leads will be described hereinafter with reference to FIG. 14. First, a copper alloy or 42 alloy thin sheet of a thickness on the order of 0.25 mm (a lead frame blank 1410) is cleaned perfectly (FIG. 14(a)). Then, a photoresist, such as a water-soluble casein photoresist containing potassium dichromate as a sensitive agent, is spread in photoresist films 1420 over the major surfaces of the thin film as shown in FIG. 14(b).

10 Then, the photoresist films are exposed, through a mask of a predetermined pattern, to light emitted by a high-pressure mercury lamp, and the thin sheet is immersed in a developer for development to form a patterned photoresist film 1430 as shown in FIG. 14(c). Then, the thin sheet is subjected, when need be, to a hardening process, a washing process and such, and then an etchant containing ferric chloride as a principal component is sprayed against the thin sheet 1410 to etch through portions of the thin sheet 1410 not coated with the patterned photoresist films 1020 so that inner leads of predetermined sizes and shapes are formed as shown in FIG. 14(d).

Then, the patterned resist films are removed, the patterned thin sheet 1410 is washed to complete a lead frame having the inner leads of desired shapes as shown in FIG. 14(e). Predetermined areas of the lead frame thus
5 formed by the etching process are silver-plated. After being washed and dried, an adhesive polyimide tape is stuck to the inner leads for fixation, predetermined tab bars are bent, when need be, and the die pad depressed. In the etching process, the etchant etches the thin sheet in both
10 the direction of the thickness and directions perpendicular to the thickness, which limits the miniaturization of inner lead pitches of lead frames. Since the thin sheet is etched from both the major surfaces as shown in FIG. 14 during the etching process, it is said, when the lead frame
15 has a line-and-space shape, that the smallest possible intervals between the lines are in the range of 50 to 100% of the thickness of the thin sheet. From the viewpoint of forming the outer lead having a sufficient strength, generally, the thickness of the thin sheet must be about
20 0.125 mm or above. Furthermore, the width of the inner leads must be in the range of 70 to 80 μ m for successful wire bonding. When the etching process as illustrated in FIG. 14 is employed in fabricating a lead frame, a thin sheet of a small thickness in the range of 0.125 to 0.15 mm
25 is used and inner leads are formed by etching so that th

fine tips thereof are arranged at a pitch of about 0.1 mm.

However, recent miniature resin-encapsulated semiconductor package requires inner leads arranged pitches in the range of 0.13 to 0.15 mm, far smaller than 0.165 mm. When a lead frame is fabricated by processing thin sheet of a reduced thickness, the strength of the outer leads of such a lead frame is not large enough to withstand external forces that may be applied thereto in the subsequent processes including an assembling process and a chip mounting process. Accordingly, there is a limit to the reduction of the thickness of the thin sheet to enable the fabrication of a minute lead frame having fine leads arranged at very small pitches by etching.

An etching method previously proposed to overcome such difficulties subjects a thin sheet to an etching process to form a lead frame after reducing the thickness of portions of the thin sheet corresponding to the inner leads of the lead frame by half etching or pressing to form the fine inner leads by etching without reducing the strength of the outer leads. However, problems arise in accuracy in the subsequent processes when the lead frame is formed by etching after reducing the thickness of the portions corresponding to the inner leads by pressing; for example, the smoothness of the surface of the plated areas

is unsatisfactory, the inner leads cannot be formed in a flatness and a dimensional accuracy required to clamp the lead frame accurately for bonding and molding, and a platemaking process must be repeated twice making the lead fabricating process intricate. It is also necessary to repeat a platemaking process twice when the thickness of the portions of the thin sheet corresponding to the inner leads is reduced by half etching before subjecting the thin sheet to an etching process for forming the lead frame, which also makes the lead frame fabricating process intricate. Thus, this previously proposed etching method has not yet been applied to practical lead frame fabricating processes.

(SUBJECT MATTERS TO BE SOLVED BY THE INVENTION)

On the other hand, because a pitch among inner leads is made narrow as the number of terminals is increased, it is considered important to know whether a problem is caused or not in association with position shift or coplanarity of an outer lead when implementing a chip mounting process. Accordingly, the present invention has been made in an effort to solve the problems occurring in the related art, and an object of the present invention is to provide a resin-encapsulated semiconductor device capable of meeting the requirement for an increase in the number of terminals

and resolving problems which are caused in association with position shift and coplanarity of an outer lead.

[MEANS FOR SOLVING THE SUBJECT MATTERS:]

5 According to one aspect of the present invention there is provided a resin-encapsulated semiconductor device using a lead frame which is shaped in accordance with a two-step etching process to a body wherein a thickness of inner leads is less than that of the lead frame blank, comprising: inner leads having the thickness less than
10 of the lead frame blank; and terminal columns electrically connected to the inner leads and having the same thickness as with the lead frame blank, the terminal columns possessing a column-shaped configuration which is adapted to be
15 electrically connected to an external circuit, the terminal columns being disposed outside of the inner leads in a manner such that they are coupled to the inner leads in a direction orthogonal to the thickness-wise direction thereof, the terminal columns having terminal portions
20 arranged on top ends thereof, the terminal portions being made of solders, etc. and exposed to the outside beyond the resin encapsulate, outer surfaces of the terminal columns also being exposed to the outside beyond the resin encapsulate, each inner lead possessing a rectangular
25 cross-section and having four surfaces including a

surface, a second surface, a third surface and a fourth surface, the first surface being flushed with one surf-
of a remaining portion of the inner lead having the same
thickness with the lead frame blank while being opposed
5 the second surface, and each of the third and fourth
surfaces having a concave shape depressed toward the inside
of the inner lead.

According to another aspect of the present invention
there is provided a resin-encapsulated semiconductor device
10 using a lead frame which is shaped in accordance with
two-step etching process to a body wherein a thickness
inner leads is less than that of the lead frame blank
comprising: inner leads having the thickness less than that
of the lead frame blank; and terminal columns integrally
15 connected to the inner leads and having the same thickness
with the lead frame blank, the terminal columns possessing
a column-shaped configuration which is adapted to be
electrically connected to an external circuit, the terminal
columns being disposed outside of the inner leads in a
20 manner such that they are coupled to the inner leads in a
direction orthogonal to the thickness-wise direction
thereof, portions of top ends of the terminal columns being
exposed to the outside beyond a resin encapsulate, outer
surfaces of the terminal columns also being exposed to the
25 outside beyond the resin encapsulate, each inner lead

possessing a rectangular cross-section and having four surfaces including a first surface, a second surface, a third surface and a fourth surface, the first surface being flushed with one surface of a remaining portion of the inner lead having the same thickness with the lead frame blank while being opposed to the second surface, and each of the third and fourth surfaces having a concave shape depressed toward the inside of the inner lead.

According to another aspect of the present invention, a semiconductor chip is received inward of the inner leads, and electrodes (pads) of the semiconductor chip are electrically connected to the inner leads through wires, respectively. According to another aspect of the present invention, the lead frame has a die pad, and the semiconductor chip is mounted onto the die pad. According to another aspect of the present invention, the lead frame does not have a die pad, and the semiconductor chip is fastened to the inner leads using a reinforcing fastener tape. According to still another aspect of the present invention, the semiconductor chip is fastened by means of insulating adhesive to the second surfaces of the inner leads on one surface thereof on which the electrodes are located, and the electrodes of the semiconductor chip are electrically connected to the first surfaces of the inner leads through wires, respectively. According to yet still

another aspect of the present invention, the semiconductor chip is fastened to the second surfaces of the inner leads by bumps thereby to be electrically connected to the inner leads. In the above descriptions, in the case that the terminal columns have terminal portions which are arranged on top ends of the terminal columns, with the terminal portions made of solders, etc. and exposed to the outside beyond the resin encapsulate, while it is the norm that the terminal portions comprising the solders, etc. are exposed to the outside beyond the resin encapsulate, it is not necessarily required for the terminal portions to be projected beyond the resin encapsulate. Moreover, while it is possible to use the outside surfaces of the terminal columns while they are not encapsulated by the resin encapsulate and they are exposed to the outside, the outside surfaces of the terminal columns which are not encapsulated by the resin encapsulate, can be covered by a protective frame using adhesive, etc.

20 [WORKING FUNCTIONS]

The resin-encapsulated semiconductor device in accordance with the present invention can meet a demand for an increase in the number of terminals. At the same time, in the resin-encapsulated semiconductor device, because the forming process of the outer leads as in the case of using

a mono-layered lead frame shown in FIG. 13(b) is not required, it is possible to provide a semiconductor device in which no problems are caused in association with position shift and coplanarity of the outer leads. More particularly, the use of a multi-pinned lead frame shaped in a manner that inner leads have a thickness less than that of the lead frame blank by a two-step etching process, that is, the inner leads are arranged at a fine pitch, can meet a demand for an increase in the pin number of the semiconductor device. Furthermore, by using the lead frame which is fabricated by a two-step etching process as will be described later with reference to FIG. 1, the second surface of each inner lead has coplanarity, and is excellent in wire-bonding property. In addition, since the first surface of the inner lead is also a flat surface and the third and fourth surfaces are depressed toward the inside of the inner lead, the inner leads are stable and coplanarity width upon wire bonding process can be enlarged.

[EMBODIMENTS]

Embodiments of the resin-encapsulated semiconductor device in accordance with the present invention will now be described with reference to the attached drawings. First, a resin-encapsulated semiconductor device in accordance

With a first embodiment of the present invention described hereinafter with reference to FIGS. 1. FIG. 1(a) is a cross-sectional view of the encapsulated semiconductor device according to the embodiment of the present invention. FIG. 1(b) is a sectional view of an inner lead taken along the line of FIG. 1(a), and FIG. 1(c) is a cross-sectional view of a terminal column taken along the line B1-B2 of FIG. 1. Moreover, FIG. 2(a) is a perspective view of the encapsulated semiconductor device according to the embodiment of the present invention, FIG. 2(b) is a view of the resin-encapsulated semiconductor device of FIG. 2(a), and FIG. 2(c) is a bottom view of the encapsulated semiconductor device of FIG. 2(a). In FIGS. 1 and 2, a drawing reference numeral 100 represents an encapsulated semiconductor device, 110 a semiconductor chip, 111 electrodes (pads), 120 wires, 130 a lead, 131 inner leads, 131Aa a first surface, 131Ab a second surface, 131Ac a third surface, 131Ad a fourth surface, 132A terminal columns, 133A terminal portions, 133B top surfaces, 133S a top surface, 135 a die pad, and 140 a resin encapsulate.

In the resin-encapsulated semiconductor device according to the first embodiment, as shown in FIG. 1, the semiconductor chip 110 is placed inward of the

leads 131. As can be readily seen from FIG. 1(a), the semiconductor chip 110 is mounted on the die pad 133 at one surface thereof which is opposed to the other surface thereof where the electrodes (pads) 111 of the semiconductor chip 110 are arranged. Each electrode pad 111 is electrically connected to the second surface 131Aa of the inner lead 131 through the wire 120. The electrical connection between the resin-encapsulated semiconductor device 100 of this embodiment and an external circuit is achieved by mounting the resin-encapsulated semiconductor device 100 via the terminal portions 133A each being made of a semi-spherical solder, on a printed circuit substrate, with the terminal portions 133A located on the top surfaces 133S of the terminal columns 133, respectively. In the resin-encapsulated semiconductor device of the first embodiment of the present invention, it is not necessarily required to provide a protective frame 190, and instead, a structure, as shown in FIG. 1(d), in which no protective frame is used can be adopted.

The lead frame 130 used in the semiconductor device 100 according to the first embodiment is made of a 42% nickel-iron alloy. Therefore, the lead frame 130A which has a contour as shown in FIG. 9(a) and is shaped by an etching process, is used as the lead frame 130. The lead frame 130 has inner leads 131 which are shaped to have a

thickness less than that of the terminal columns 133 or other portions. Dam bars 136 serve as a dam when encapsulating the semiconductor chip 110 with a resin. Moreover, although the lead frame 130A which is processed by etching to have the contour as shown in FIG. 9A is used in this embodiment, the lead frame is not limited to such a contour because portions except the inner leads 131 and the terminal columns 133 are not necessary. The inner leads 131 have a thickness of 40 μ m whereas the portions of the lead frame 130 other than the inner leads 131 have a thickness of 0.15 mm which corresponds to the thickness of the lead frame blank. The other portions of the lead frame 130 except the inner leads 131 may not have the thickness of 0.15 mm, but have a thickness of 0.125 mm-0.50 mm which is thinner. The tips of the inner leads 131 have a small pitch of 0.12 mm so as to achieve an increase in the number of terminals for semiconductor devices. The second face 131Ab of the inner lead 131 has a substantially flat profile so as to allow an easy wire bonding thereon. Also, as shown in FIG. 1(b), because the third and fourth faces 131Ac and 131Ad have a concave shape which is depressed toward the inside of the associated inner lead, a high strength can be obtained even though the second face (wire bonding surface) 131Ab is narrowed.

In the present embodiment, since twisting does not

occur in the inner leads 131 irrespective of whether the inner leads 131 is long or not. The inner leads having the contour, as shown in FIG. 9(a), in which the tips of the inner leads 131 are separated one from another, are prepared by the etching process, and the inner leads are resin-encapsulated after mounting the semiconductor chip thereon as will be described later. However, where the inner leads 131 are long in their length and have a tendency for the generation of twisting therein, it is impossible to fabricate the lead frame by etching to have the contour as shown in FIG. 9(a). Therefore, after etching the lead frame in a state where the tips of the inner leads are fixed to the connecting portion 131B as shown in FIG. 9(c)(1), the inner leads 131 are fixed with the reinforcing tape 160 as shown in FIG. 9(c)(2). Then, the connecting portions 131B which are not necessary in the fabrication of the resin-encapsulated semiconductor device are removed by a press as shown in FIG. 9(c)(3), and a semiconductor device is then mounted on the lead frame.

Hereinafter, a method for the fabrication of the resin-encapsulated semiconductor device will now be described with reference to FIG. 8. First, the lead frame 130A, as shown in FIG. 9(a), which is shaped by the etching process as will be described later, is prepared such that the second surfaces 131Ab of the inner leads 131 are

directed upward (FIG. 8(a)).

Then, the semiconductor chip 110 is mounted onto the die pad 135 such that the surfaces of the semiconductor chip 110 on which the electrodes 111 are arranged, are directed upward (FIG. 8(b)).

Next, after the semiconductor chip 110 is fastened onto the die pad 135, the electrodes 111 of the semiconductor chip 110 and the second surfaces 131ab of the inner leads 131 are bonded with each other using wires 110 (FIG. 8(c)).

Subsequently, encapsulation is carried out with the conventional resin encapsulate 140. Thereafter, unnecessary portions of the lead frame 130 which are protruded from the resin encapsulate 140 are cut by a press to form terminal columns 133 and also the side surfaces 133B of the terminal columns 133 (FIG. 8(d)).

Then, the dam bars 136, the frame portions 137, etc. of the lead frame 130A as shown in FIG. 9 are removed. Next, the terminal portions 133A each made of the semi-spherical solder are arranged on the outer surface of each terminal column 133 to fabricate a resin-encapsulated semiconductor device (FIG. 8(e)).

Thereafter, the protective frame 180 is arranged by means of adhesive around an entire outer surface of the resultant structure in such a manner that the side surfaces

of the terminal columns 133 are covered thereby FIG. 6(f)). At this time, the protective frame 180 functions to reinforce the semiconductor device. In other words, the protective frame 180 serves to prevent moisture from
5 leaking into a gap between the resin encapsulate and the terminal columns due to the fact that the side surfaces of the terminal columns are exposed to the outside, whereby a crack is not formed in the semiconductor device and the breakage of the semiconductor device is avoided. However,
10 persons skilled in the art will readily appreciate that it is not necessarily required to provide the protective frame 180. Also, when such an encapsulating process by the resin is carried out using a desired mold, the encapsulating process is implemented in a state wherein the outer side
15 surfaces of the terminal columns of the lead frame are somewhat protruded out of the resin encapsulate.

A method for etching the lead frame of the first embodiment will now be described in conjunction with the attached drawings. FIG. 11 is of cross-sectional views
20 respectively illustrating sequential steps of the etching process for the lead frame of the first embodiment. In particular, the cross-sectional views of FIG. 1 correspond to a cross section taken along the line D1-D2 of FIG. 9(a). In FIG. 11, the reference numeral 1110 denotes a lead frame
25 blank, 1120A and 1120B resist patterns, 1130 first opening,

1140 second openings, 1150 first concave portions, 1160 second concave portions, 1170 flat surfaces, and 1180 an etch-resistant layer. First, a water-soluble casein resist using potassium dichromate as a sensitive agent is coated
5 over both surfaces of the lead frame blank 1110 made of a 42% nickel-iron alloy and having a thickness of about 0.15 mm. Using desired pattern plates, the resist films are patterned to form resist patterns 1120A and 1120B having first opening 1130 and second openings 1140, respectively
10 (FIG. 11(a)).

The first opening 1130 is adapted to etch the lead frame blank 1110 to have a flat etched bottom surface to a thickness smaller than that of the lead frame blank 1110 in a subsequent process. The second openings 1140 are adapted
15 to form desired shapes of tips of inner leads. Although the first opening 1130 includes at least an area forming the tips of the inner leads 1110, a topology generated by partially thinned portion by etching in a subsequent process can cause hindrance in a taping process or a
20 clamping process for fixing the lead frame. Thus, an area to be etched needs to be large without being limited to fine portions of the tips of the inner leads. Thereafter, both surfaces of the lead frame blank 1110 formed with the resist patterns are etched using a 48 Be' ferric chloride
25 solution of a temperature of 57°C at a spray pressure of

2.5 kg/cm². The etching process is terminated at the point of time when first recesses 1150 etched to have a flat etched bottom surface have a depth h corresponding to $2/3$ of the thickness of the lead frame blank (FIG. 11a).

5 Although both surfaces of the lead frame blank 1110 are simultaneously etched in the primary etching process, it is not necessary to simultaneously etch both surfaces of the lead frame blank 1110. The reason why both surfaces of the lead frame blank 1110 are simultaneously etched, as in
10 this embodiment, is to reduce the etching time taken in a secondary etching process as will be described later. The total time taken for the primary and secondary etching processes is less than that taken in the case of etching of only one surface of the lead frame blank on which the resist pattern 1120B is formed. Subsequently, the surface
15 provided with the first recesses 1150 respectively etched at the first opening 1130 is entirely coated with an etch-resistant hot-melt wax (acidic wax type MR-WB6, The Inctec Inc.) by a die coater to form an etch-resistant layer 1180 so as to fill up the first recesses 1150 and to
20 cover the resist pattern 1120A (FIG. 11(c)).

It is not necessary to coat the etch-resistant layer 1180 over the entire portion of the surface provided with the resist pattern 1120A. However, it is preferred that
25 the etch-resistant layer 1180 be coated over the entire

portion of the surface formed with the first recess
and first opening 1130, as shown in FIG. 11(c), be-
is difficult to coat the etch-resistant layer 1180 on
the surface portion including the first recesses.
5 Although the etch-resistant layer 1180 wax employed in
embodiment is an alkali-soluble wax, any material
resistant to the etching action of the etchant solution
remaining somewhat soft during etching may be used.
for forming the etch-resistant layer 1180 is not limited
10 the above-mentioned wax, but may be a wax of a UV-cure
type. Since each first recess 1130 etched by the pre-
etching process at the surface formed with the paste
adapted to form a desired shape of the inner lead tip
filled up with the etch-resistant layer 1180, it is
15 further etched in the following secondary etching process.
The etch-resistant layer 1180 also enhances the mechanical
strength of the lead frame blank for the second etching
process, thereby enabling the second etching process to be
conducted while keeping a high accuracy. It is
20 possible to enable a second etchant solution to be sprayed
at an increased spraying pressure, for example, 2.5 kg
or above, in the secondary etching process. The increased
spraying pressure promotes the progress of etching in the
direction of the thickness of the lead frame blank in
25 secondary etching process. Then, the lead frame blank

subjected to a secondary etching process. In this secondary etching process, the lead frame blank 1110 is etched at its surface formed with first recesses 1130 having a flat etched bottom surface, to completely
5 perforate the second recesses 1160, thereby forming the tips of inner leads 131A (FIG. 11B)).

The bottom surface 1170 of each recess formed by the primary etching process is flat. However, both side surfaces of each recess positioned at opposite sides of the
10 bottom surface 1170 have a concave shape depressed toward the inside of the inner lead. Then, the lead frame blank is cleaned. After completion of the cleaning process, the etch-resistant layer 1180, and resist films (resist patterns 1120A and 1120B) are sequentially removed. Thus,
15 a lead frame 130A having a structure of FIG. 9(a) is obtained in which tips of the inner leads 131A are arranged at a fine pitch. The removal of the etch-resistant layer 1180 and resist films (resist patterns 1120A and 1120B) is achieved using a sodium hydroxide solution serving to
20 dissolve them.

The processes for manufacturing the lead frame as shown in FIG. 11, is to form by means of etching the lead frame having the tips of the inner leads used in this
25 embodiment of the present invention, which have a thickness less than that of the lead frame. Especially, the first

surfaces 131Aa of the tips of the inner leads as shown in
FIG. 1, are flushed with one surfaces of remaining portions
of the inner leads having the same thickness with the lead
frame while being opposed to the second surfaces 131Ab, and
5 the third and fourth surfaces are formed to have a concave
shape which is depressed toward the inside of the inner
leads. Where a semiconductor chip is mounted on the second
surfaces 131Ab of the inner leads by means of bumps for an
electrical connection therebetween, as in a semiconductor
10 device according to a third embodiment as will be described
hereinafter, an increased tolerance for the connection by
bumps is obtained when the second surface 131Ab has a
concave shape depressed toward the inside of the inner
lead. To this end, an etching method shown in FIG. 12 is
15 adopted in this case. The etching method shown in FIG. 12
is the same as that of FIG. 11 in association with its
primary etching process. After completion of the primary
etching process, the etching method is conducted in a
manner different from that of the etching method of FIG. 11
20 in that the second etching process is conducted at the side
of the first recesses 1150 after filling up the second
recesses 1160 by the etch-resist layer 1180, thereby
completely perforating the second recesses 1160. At this
time, by implementing the primary etching process, etching
25 at the side of the second openings 1140 is performed in a

sufficient manner. The cross section of each inner lead, including its tip, formed in accordance with the etching method of FIG. 12, has a concave shape depressed toward the inside of the inner lead at the second surface 131Ab, as shown in FIG. 6(b).

The etching method in which the etching process is conducted at two separate steps, respectively, as in that of FIGs. 11 and 12, is generally called a "two-step etching method". This etching method is advantageous in that a desired fineness can be obtained. The etching method used to fabricate the lead frame 130A of the first embodiment shown in FIG. 9 involves the two-step etching method and the method for forming a desired shape of each lead frame portion while reducing the thickness of each pattern formed. In particular, the etching method makes it possible to achieve a desired fineness. In accordance with the method illustrated in FIGs. 11 and 12, the fineness of the tip of each inner lead 131A formed by this method is dependent on the shape of the second recesses 1160 and the thickness t of the inner lead tip which is finally obtained. For example, where the blank has a thickness t reduced to 50 μ m, the inner leads can have a fineness corresponding to a lead width W_1 of 100 μ m and a tip pitch p of 0.15 mm, as shown in FIG. 11(e). In the case of using a small blank thickness t of about 30 μ m and a lead

width W_1 of 70 μm , it is possible to form inner leads having a fineness corresponding to an inner lead pitch p of 0.12 mm. Of course, it may be possible to form inner leads having a further reduced tip pitch by adjusting the blank thickness t and the lead width W_1 . That is to say, an inner lead tip pitch p up to 0.08 mm, a blank thickness up to 25 μm , and a lead width W_1 up to 40 μm can be obtained.

In the case where twisting of the inner leads does not occur in the fabricating process, as in the case where the inner leads are short in their length, a lead frame illustrated in FIG. 9(a) can be directly obtained. However, where the inner leads are long in length as compared to those of the first embodiment, the inner leads have tendency for the generation of twisting. Thus, in this case, the lead frame is obtained by etching in a state where the tips of the inner leads are bound to each other by a connecting member 131B as shown in FIG. 9(c)(1). Then, the connecting member 131B which is not necessary for the fabrication of a semiconductor package is cut off by means of a press to obtain a lead frame shaped as shown in FIG. 9(a).

Moreover, as described above, where unnecessary portions in a structure shown in FIG. 9(c)(1) are cut to obtain the lead frame having the contour shown in FIG.

9(a), a reinforcing tape 160 (a polyimide tape is generally used, as shown in FIG. 9(b)(A)). While the connecting member 131B is cut off by means of a press to obtain the contour shown in FIG. 9(b)(D), a semiconductor device is mounted on the lead frame still having the reinforcing tape attached thereon. Also, the mounted semiconductor device is encapsulated with a resin in a condition where the lead frame still has the tape. The line E11-E12 illustrates a cut portion.

The tip of the inner lead 131 of the lead frame used in the semiconductor device of this first embodiment has a cross-sectional shape as shown in FIG. 13(1)(a). The tip 131A has an etched flat surface (second surface) 131Ab which is substantially flat and therefore has a width $W1$ slightly greater than the width $W2$ of an opposite surface. The widths $W1$ and $W2$ (about 1000 μm) are more than the width W at the central portion of the tips when viewed in the direction of the inner lead thickness. Thus, the tip of the inner lead has a cross-sectional shape having opposite wide surfaces. To this end, although either of the opposite surfaces of the tip 131A can be easily electrically connected to a semiconductor device (not shown) by a wire 120A or 120B, this embodiment illustrates the use of the etched flat surface for wire-bonding as shown in FIG. 13(D)(a). In FIG. 13, a reference numeral

131Ab depicts an etched flat surface, 131Aa a surface of a lead frame blank, and 121A and 121B, respectively, a plated portion. In the case of FIG. 13(D)(a), there has particularly excellent in wire-bonding property, because the etched flat surface does not have roughness. FIG. 13(A) shows that the tip 1331B of the inner lead of the lead frame fabricated according to the process illustrated in FIG. 14 is wire-bonded to a semiconductor device. In this case, however, both the opposite surfaces of the tip 1331B of the inner lead are flat, but have a width smaller than that in a direction of the inner lead thickness. In addition to this, as both the opposite surfaces of the tip 1331B is formed of surfaces of the lead frame blank, these surfaces have an inferior wire-bonding property as compared to that of the etched flat surface of this first embodiment. FIG. 13(B) shows that the inner lead tip 1331C or 1331D, obtained by thinning in its thickness by a means of a press (coining) and then by etching, is wire-bonded to a semiconductor device (not shown). In this case, however, a pressed surface of the inner lead tip is not flat as shown FIG. 13(B). Thus, the wire-bonding on either of the opposite surfaces as shown in FIG. 13(B)(a) or FIG. 13(B)(b) often results in an insufficient wire-bonding stability and a problematic quality. The drawing reference numeral 1331Ab represents a coining surface.

A modified example of the resin-encapsulated semiconductor device in accordance with the first embodiment of the present invention will be described hereinafter. FIGs. 3(a) through 3(e) are cross-sectional views of the modified example of the resin-encapsulated semiconductor device in accordance with the first embodiment of the present invention. The semiconductor device of the modified example as shown in FIG. 3(a), is different from that of the first embodiment in that a position of the die pad 135 is changed, that is, the die pad 135 is exposed to the outside. By the fact that the die pad 135 is exposed to the outside, the heat dissipation property is improved as compared to the first embodiment. Also, in the semiconductor device of the modified example as shown in FIG. 3(b), because the die pad 135 is exposed to the outside, the heat dissipation property is improved as compared to the first embodiment. Unlike the first embodiment or the modified example as shown in FIG. 3(a), in the present modified example as shown in FIG. 3(b), because a direction of the semiconductor device 110 is changed, the first surfaces of the lead frame are established as the wire bonding surfaces. The modified examples as shown in FIGs. 3(c), 3(d) and 3(e), illustrate semiconductor devices which are obtained by modifying the semiconductor devices of the first embodiment, the modified

example as shown in FIG. 3(a) and the modified example as shown in FIG. 3(b), wherein the semi-spherical solders are not used, and instead, the top surfaces of the terminal columns are directly used as the terminal portions, whereby
5 an entire manufacturing procedure can be simplified.

Next, a resin-encapsulated semiconductor device in accordance with a second embodiment of the present invention will be described. FIG. 4(a) is a cross-sectional view of the resin-encapsulated semiconductor
10 device in accordance with the second embodiment of the present invention, FIG. 4(b) is a cross-sectional view illustrating inner leads, taken along the line A3-A4 of FIG. 4(a), and FIG. 4(c) is a cross-sectional view illustrating a terminal column, taken along the line B3-B4
15 of FIG. 4(a). Because an outer appearance of the semiconductor device of the second embodiment is substantially the same as that of the first embodiment, it is not illustrated in the drawings. In FIG. 3, the drawing reference numeral 200 represents a semiconductor device,
20 210 a semiconductor chip, 211 electrodes (pads), 220 wires, 230 a lead frame, 231 inner leads, 231Ab a second surface, 231Ac a third surface, 231Ad a fourth surface, 233 terminal columns, 233A terminal portions, 233B side surfaces, 233S top surfaces, 240 a resin encapsulate, and 270 a
25 reinforcing fastener tape. In the semiconductor device of

5 this second embodiment, the lead frame 230 does not have a die pad, the semiconductor chip 210 is fastened to the inner leads 231 by the reinforcing fastener tape 270, and the semiconductor chip 210 is electrically connected at its electrodes (pads) 211 to the second surfaces 231Ab of the inner leads 231 by wires 220. Also, in the case of this second embodiment, similarly to the first embodiment, the electrical connection between the resin-encapsulated semiconductor device 200 of this embodiment and an external circuit is achieved by mounting the resin-encapsulated semiconductor device 200 via the terminal portions 233A each being made of a semi-spherical solder, on a printed circuit substrate, with the terminal portions 233A located on the top surfaces 233S of the terminal columns 233, respectively.

10 In addition, the semiconductor device of this second embodiment does not have a die pad as shown in FIGs. 10(a) and 10(b). The manufacturing method of the semiconductor device of this embodiment using the lead frame 230A which is shaped by the etching process is substantially the same as that of the first embodiment except that, while in the case of the first embodiment, the wire bonding process and resin encapsulating process are performed in a state wherein the semiconductor chip is fastened to the inner leads, in the case of the second embodiment, the wire

bonding process and resin encapsulating process are performed in a state wherein the semiconductor chip 210 is fastened together with the inner leads 231 by the reinforcing fastener tape 270. Also, the cutting process for the unnecessary portions and the terminal portion forming process after resin encapsulating process are implemented in the same way as the first embodiment. The lead frame 230 as shown in FIG. 10(a) is obtained in the same manner by which the lead frame 130A as shown in FIG. 9(a) is obtained. In other words, by cutting the resultant structure obtained after etching the structure as shown in FIG. 10(c)(1), the contour as shown in FIG. 10(a) is obtained. At this time, the conventional reinforcing fastener tape 260 (the polyimide tape) as shown in FIG. 10(c)(2), which performs a reinforcing function is used.

FIG. 5(a) through 5(c) are cross-sectional views illustrating modified examples of the semiconductor device of the second embodiment. The semiconductor device as shown in FIG. 5(a) is different from the semiconductor device of the second embodiment, in that the surface of the semiconductor chip thereof which has the electrodes is directed downward. The modified examples as shown in FIGs. 5(b) and 5(c), illustrate semiconductor devices which are obtained by modifying the semiconductor devices of the second embodiment and the modified example as shown in FIG.

5(a), wherein the semi-spherical solders are not used, and instead, the top surfaces of the terminal columns are directly used as the terminal portions. In these examples, because a protective frame is not used and the side surfaces 333B of the terminal columns 333 are exposed to the outside, a checking operation by a test, etc. can be easily performed.

Hereinafter, a resin-encapsulated semiconductor device in accordance with a third embodiment of the present invention will be described. FIG. 6(a) is a cross-sectional view of the resin-encapsulated semiconductor device of the third embodiment, FIG. 6(b) is a cross-sectional view illustrating inner leads, taken along the line A5-A6 of FIG. 6(a), and FIG. 6(c) is a cross-sectional view illustrating a terminal column, taken along the line B5-B6 of FIG. 6(b). Because an outer appearance of the semiconductor device of the this third embodiment is substantially the same as that of the first embodiment, it is not illustrated in the drawings. In FIG. 6, the drawing reference numeral 300 represents a semiconductor device, 310 a semiconductor chip, 312 bumps, 330 a lead frame, 331 inner leads, 331Aa a first surface, 331Ab a second surface, 331Ac a third surface, 331Ad a fourth surface, 333 terminal columns, 333A terminal portions, 333B side surfaces, 333S top surfaces, 340 a resin encapsulate, and 350 a

reinforcing fastener tape. In the semiconductor device of this third embodiment, the semiconductor chip 310 is fastened to the second surfaces 331Ab of the inner leads 331 by the bumps 311 thereby to be electrically connected to the second surfaces 331Ab. The lead frame 330 has a contour as shown in FIGs. 10(a) and 10(b), which is formed by the etching process of FIG. 11. As shown in FIG. 13(1)(b), both widths W1A and W2A (about 100 μ m) at top and bottom ends of the inner leads 331 are larger than a width WA at a center portion in a thickness-wise direction. Due to the fact that the second surfaces 331Ab of the inner leads 331 is depressed toward the inside of the inner leads and the first surfaces 331Aa are flat, a desired fineness can be obtained. Also, when the second surfaces 331Ab of the inner leads 331 are electrically connected to the semiconductor chip via bumps, easy connection can be accomplished as shown in FIG. 13(2)(b). Further, in the case of this third embodiment, as in the case of the first and second embodiments, the electrical connection between the resin-encapsulated semiconductor device 300 of this embodiment and an external circuit is achieved by mounting the resin-encapsulated semiconductor device 300 via the terminal portions 333A each being made of a semi-spherical solder, on a printed circuit substrate, with the terminal portions 333A located on the top surfaces of the terminal

columns 333, respectively.

In addition, unlike the semiconductor device of the first embodiment, the semiconductor device of this third embodiment uses a lead frame which is shaped by the etching process as shown in FIG. 12. However, the manufacturing method of the semiconductor device of this embodiment is substantially the same as that of the first embodiment except that, while in the case of the first embodiment, the wire bonding process and resin encapsulating process are performed in a state wherein the semiconductor chip is fastened to the inner leads, in the case of this third embodiment, the wire bonding process and resin encapsulating process are performed in a state wherein the semiconductor chip 310 is fastened to the inner leads 331 via the bumps. Also, the cutting process for the unnecessary portions and the terminal portion forming process after resin encapsulating process are implemented in the same way as the first embodiment.

FIG. 6(d) is a cross-sectional view illustrating a modified example of the semiconductor device in accordance with the third embodiment of the present invention. In the modified example of the semiconductor device as shown in FIG. 6(d), the terminal portions each comprising the semi-spherical solder are not provided, and the top surfaces of the terminal columns are directly used as the terminal

portions. Because the protective frame is not used and the side surfaces 333B of the terminal columns 333 are exposed to the outside, a checking operation by a test, etc. can be easily performed.

5 Hereinafter, a resin-encapsulated semiconductor device in accordance with a fourth embodiment of the present invention will be described. FIG. 7(a) is a cross-sectional view of the resin-encapsulated semiconductor device of the fourth embodiment, FIG. 7(b) is a cross-sectional view illustrating inner leads, taken along the line A7-A8 of FIG. 7(a), and FIG. 7(c) is a cross-sectional view illustrating a terminal column, taken along the line 10 B7-B8 of FIG. 7(b). Because an outer appearance of the semiconductor device of the this fourth embodiment is substantially the same as that of the first embodiment, it is not illustrated in the drawings. In FIG. 7, the drawing reference numeral 400 represents a semiconductor device, 15 410 a semiconductor chip, 411 pads, 430 a lead frame, 431 inner leads, 431Aa a first surface, 431Ab a second surface, 431Ac a third surface, 431Ad a fourth surface, 433 terminal columns, 433A terminal portions, 433B side surfaces, 433S top surfaces, 440 a resin encapsulate, and 470 insulating adhesive. In the semiconductor device of this fourth 20 embodiment, one surface of the semiconductor chip 410 on which the pads 411 are disposed is fastened to the second 25

surfaces 431Ab of the inner leads 431 by the insul-
adhesive 470, and the pads 411 and the first surfaces
of the inner leads 431 are electrically connected with
other by wires 420. The semiconductor device of
5 fourth embodiment uses the same lead frame which is use
the third embodiment, which has the contour as shown
FIG. 10(a) and 10(b). Also, in the case of this fourth
embodiment, as in the case of the first and second
embodiments, the electrical connection between the res-
10 encapsulated semiconductor device 400 of this embodiment
and an external circuit is achieved by mounting the res-
encapsulated semiconductor device 400 via the terminal
portions 433A each being made of a semi-spherical solder
on a printed circuit substrate, with the terminal portio-
15 433A located on the top surfaces of the terminal columns
433, respectively.

FIG. 7(d) is a cross-sectional view illustrating
modified example of the semiconductor device in accordance
with the fourth embodiment of the present invention. In
20 the modified example of the semiconductor device as shown
in FIG. 7(d), the terminal portions each comprising the
semi-spherical solder are not provided, and the top
surfaces of the terminal columns are directly used as the
terminal portions. Because the protective frame is not
25 used and the side surfaces 433B of the terminal columns 433

are exposed to the outside, a checking operation by a test, etc. can be easily performed.

(EFFECTS OF THE INVENTION)

5 The present invention provides a resin-encapsulated semiconductor device employing the above-mentioned lead frame, which is capable of meeting a demand for the increased terminal number. Furthermore, the resin-encapsulated semiconductor device in accordance with this invention does not require a process of cutting or bending
10 the dam bars as in the case of using a lead frame having outer leads as shown in FIG. 13(b). As a result of this, the resin-encapsulated semiconductor device does not have a problem in that the outer leads are bent, or a problem associated with coplanarity. In addition to these
15 advantages, the resin-encapsulated semiconductor device has a shortened interconnection length as compared to the QTP or the BGA, whereby the semiconductor device can be reduced in a parasitic capacity, and shortened in a transfer delay
20 time.

59:543 v:

(11) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(13) 特許出願公開番号

特開平 9-8205

(14) 公報日 平成 9 年 (1997) 1 月 13 日

(15) Int. Cl.

H01L 23/58

発明の名称

半導体装置

F I

H01L 23/58

特許表示

12/12

12/12

- 1

A

L

特許請求の範囲 請求項 1 全 1 頁

(11) 出願番号 特願 7-170490

(12) 出願日 平成 7 年 (1995) 6 月 14 日

(13) 出願人 000002897

大日本印刷株式会社

東京都新宿区西新宿一丁目 1 番 1 号

(14) 発明者 山田 誠一

東京都新宿区西新宿一丁目 1 番 1 号

大日本印刷株式会社内

(15) 発明者 佐々木 賢

東京都新宿区西新宿一丁目 1 番 1 号

大日本印刷株式会社内

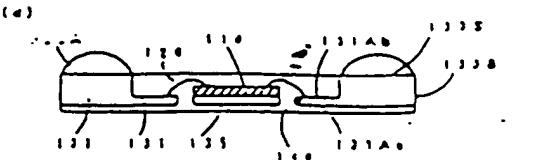
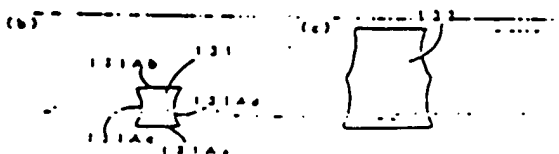
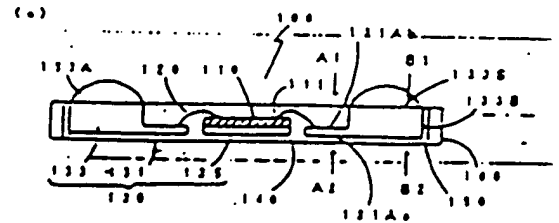
(16) 代理人 弁護士 小西 誠美

(17) (発明の名称) 断層防止型半導体装置

(18) (要約) (形正書)

【目的】 多層化に対応でき、且つ、アウターリードの位置ズレや平坦性の問題にも対応できる断層防止型半導体装置を提供する。

【構成】 一体的に形成したリードフレーム部と同一層との外装部とを積層するたりの状の端子部 133 とを有し、且つ、端子部はインナーリードの外装側においてインナーリードに対して厚み方向に偏して設けられており、端子部の先端部に半導体からなる端子部を露出させ、端子部を断層防止部から露出させ、端子部の外装側の断面を断層防止部から露出させており、インナーリードは、断面形状が略円形であり、第 1 面 131Aa、第 2 面 131Ab、第 3 面 131Ac、第 4 面 131Ad の 4 面を有しており、かつ第 1 面はリードフレーム部と同じ層との部分の一方の面と同一平面上にあって第 2 面に向をきっており、第 3 面、第 4 面はインナーリードの内側に面を向けておられ、略円形に形成されている。



【実施例の概略】

【請求項1】 2層エッチング加工によりインターリードの厚さがリードフレーム素材の厚さより厚肉に形成されたリードフレームを用いた半導体装置であって、前記リードフレームは、リードフレーム素材より厚肉のインターリードと、該インターリードに一体的に形成したリードフレーム素材と同じ厚さの外部回路とを形成するための形状の導子部とを有し、且つ、導子部はインターリードの外周側においてインターリードに対して厚み方向に直交して設けられており、導子部の先端部に半導体からなる導子部を設け、導子部を封止用樹脂層から露出させ、導子部の先端側の端面を封止用樹脂層から露出させており、インターリードは、断面形状が四方形であり、第1面、第2面、第3面、第4面の4面を有しており、かつ第1面はリードフレーム素材と同じ厚さの他の部分の一方の面と同一直線上にあって第2面に向を合っており、第3面、第4面はインターリードの内側に向かって凹んだ形状に形成されていることを特徴とする半導体装置。

【請求項2】 2層エッチング加工によりインターリードの厚さがリードフレーム素材の厚さより厚肉に形成加工されたリードフレームを用いた半導体装置であって、前記リードフレームは、リードフレーム素材より厚肉のインターリードと、該インターリードに一体的に形成したリードフレーム素材と同じ厚さの外部回路とを形成するための形状の導子部とを有し、且つ、導子部はインターリードの外周側においてインターリードに対して厚み方向に直交して設けられており、導子部の先端の一部を封止用樹脂層から露出させて導子部とし、導子部の先端側の端面を封止用樹脂層から露出させており、インターリードは、断面形状が四方形で第1面、第2面、第3面、第4面の4面を有しており、かつ第1面はリードフレーム素材と同じ厚さの他の部分の一方の面と同一直線上にあって第2面に向を合っており、第3面、第4面はインターリードの内側に向かって凹んだ形状に形成されていることを特徴とする半導体装置。

【請求項3】 請求項1ないし2において、半導体素子はインターリード間に設けられ、該半導体素子の電極部はワイヤにてインターリードと電気的に接続されていることを特徴とする半導体装置。

【請求項4】 請求項3において、リードフレームはダイパッドを有しており、半導体素子はダイパッド上に搭載され、固定されていることを特徴とする半導体装置。

【請求項5】 請求項3において、リードフレームはダイパッドを持たないもので、半導体素子はインターリードととらに高強度接着テープにより固定されていることを特徴とする半導体装置。

【請求項6】 請求項1ないし2において、半導体素子は半導体素子の電極部をインターリードの第2面

に形成された導子部により固定されており、該半導体素子の電極部はワイヤによりインターリードの第1面と電極部に接続されていることを特徴とする半導体装置。

【請求項7】 請求項1ないし2において、半導体素子はパンプによりインターリードの第2面に固定されて電気的にインターリードと接続していることを特徴とする半導体装置。

【発明の効果】

【0001】

【従来の技術】 本発明は、半導体装置の多ピン化に対応して、且つ、アフターリードの低コスト化（スキュー）やアフターリードの半導体（コブラリテュー）の容易化を図る、リードフレームを用いた半導体装置に関する。

【0002】

【従来の技術】 従来のように用いられている半導体装置（プラスチックリードフレームパッケージ）は、一般に図15（a）に示されるような構造であり、

半導体素子1510を搭載するダイパッド1511の半導体素子との電気的接続を行うためのアフターリード1513、アフターリード1513に一体となったインターリード1512、該インターリード1512の先端部と半導体素子1520の電極パッド1521とを電気的に接続するためのワイヤ1530、半導体素子1520を封止して外部からの応力、熱から守る樹脂1540面からなっており、半導体素子1520をリードフレームのダイパッド1511に搭載した状態で、

樹脂1540により封止してパッケージとしたもので、半導体素子1520の電極パッド1521に接続されるインターリード1512を必要とするものである。そして、このような樹脂封止型の半導体装置の製造工程として用いられる（参照）リードフレームは、一般には図15（b）に示すような構造のもので、半導体素子を搭載するためのダイパッド1511と、ダイパッド1511の厚さに沿って設けられた半導体素子とを接続するためのインターリード1512、該インターリード1512に接続して外部回路との電気的接続を行うためのアフターリード1513、樹脂封止する際のダムとなるダムバー1514、リードフレーム1510全体を支持するフレーム（本）1515等を備えており、通常、コパール、42合金（42%ニッケル-58%金）、銅合金のような高強度に優れた合金を用い、プレス加工もしくはエッチング法により形成されていた。図15（b）（c）は、図15（b）（イ）に示すリードフレーム1510のF1-F3における断面図である。

【0003】 このようなリードフレームを用いた半導体装置（プラスチックリードフレームパッケージ）において、半導体素子の電極部をインターリードの第2面に形成された導子部により固定されており、該半導体素子の電極部はワイヤによりインターリードの第1面と電極部に接続されていることを特徴とする半導体装置。

【0004】 このように、半導体素子の電極部をインターリードの第2面に形成された導子部により固定されており、該半導体素子の電極部はワイヤによりインターリードの第1面と電極部に接続されていることを特徴とする半導体装置。

180を返ける必要はなく、図1(c)に示すような厚さ180を返けない厚さのままでよい。

(0010) 本発明1の基板装置100に使用のリードフレーム130は、42Xニッケル-銅合金を主成分としたもので、そして、図9(a)に示すような形状をした、エッチングにより形成加工されたリードフレーム130Aを用いたものであり、端子部133部分の端部の底面より背面に形成されたインターリード部131をもち、ダムバー136は背面に形成する際のダムとなる。図9(a)に示すような形状をした、エッチングにより形成加工されたリードフレーム130Aを、本発明においては用いたが、インターリード部131と端子部133以外には基本的に不要なものであるから、図9(a)の形状に限定されない。インターリード部131の厚さ1は40μm、インターリード部131以外の厚さ1は0.15mmでリードフレーム130Aの厚さのままである。インターリード部131以外の厚さは0.15mmに厚さYに厚い0.125mm-0.50mm程度でもよい。また、インターリードピッチは0.12mmと狭いピッチで、基板装置の多端子化に対応できるものとしている。インターリード部131の第2面131Aは平坦化でワイヤボンディングし易い形状となっており、図1(b)に示すように、第3面131A(=第4面131A)はインターリード部へ凹んだ形状をしており、第2面131Aはワイヤボンディング面を狭くしても凹形状に造り易いものとしている。

(0011) 本発明においては、インターリード131の各々が、インターリード131部に凹みが見えたり、図9(a)に示すような、インターリード部がそれぞれ形成された形状のリードフレームをエッチング加工して作製し、これに形成する方式により本発明を形成して製造停止している。インターリード131が広く、インターリード131部に凹みを生じ易い場合には、図9(a)に示す形状にエッチング加工することには出来ないため、図9(c1)-(c3)に示すようにインターリード先端部を端子部133Bにて固定した状態でエッチング加工した後、インターリード131部を第2面131Bにて固定し、図9(c)の(0)に示すようにプレスにて、本発明の基板装置の底面に不要の端子部133Bを形成し、この状態で本発明を形成して本発明を形成する。(図9(c))

(0012) 次に本発明1の基板装置100の製造方法を図8に基づいて順次に説明する。まず、図9(a)に示すリードフレーム130Aを、インターリード131先端の第2面131Aが第8で上になるようにして固定した。(図8(a))

次いで本発明100の端子部111側の面を図3で示すように、本発明をダイバッド135上に固定し、図

2(b)に示す。

本発明100をダイバッド135に固定した本発明100の端子部111とインターリード部112の第2面とをワイヤ120にてボンディングした。(図8(c))

次いで、図8(c)の第2面112で端子部111とインターリード部112の第2面とをワイヤ120にてボンディングした。(図8(c))

図9に示すリードフレーム130Aのダムバー136をフレーム130Aを除去した。この時、リードフレームの端子部の外面に形成された凹みから端子部133Aを除去して本発明を形成した。(図8(c))

次いで、図8(c)の第2面112で端子部111とインターリード部112の第2面とをワイヤ120にてボンディングした。(図8(c))

(0013) 本発明の基板装置100に用いるリードフレームの製造方法を以下、図10に示す。図10(a)に示すように、本発明の端子部111とインターリード部112の第2面とをワイヤ120にてボンディングした。(図8(c))

図10(a)に示すように、本発明の端子部111とインターリード部112の第2面とをワイヤ120にてボンディングした。(図8(c))

図10(a)に示すように、本発明の端子部111とインターリード部112の第2面とをワイヤ120にてボンディングした。(図8(c))

インターネットを介してアクセスした。(5:)

第1回目のエッチング加工にて作成された、リードフレーム面に平行なエッチング抵抗面には抵抗であるが、この面を再び2面はインナーリード側へこんだ抵抗である。次いで、抵抗、エッチング抵抗を9と0のレジスト画（レジストパターン1120A、1120B）のレジストを用い、インナーリード先端に1301Aが2面加工された図9（a）に示すリードフレーム130Aを作った。エッチング抵抗を1と0とレジスト画（レジストパターン1120A、1120B）のレジストに示されたパトリウム化合物により導電膜とした。

(0014) 上記、図11に示すリードフレームの加工方法に、本実施例に用いられる、インターリード先頭部を同時に形成したリードフレームをエッチング加工により製造する方法で、特に、図1に示す、インターリード先頭の第1面131Aを両側部以外の部分の部分と同一面に、第2面131ABと対面させて形成し、且つ、第3面131Ac、第4面131ACをインターリードの内側に向かって凹んだ形状にするエッチング加工方法であらう。またこの実施例の加工は従来のようにバンプを形成して金属基をインターリードの第2面131ABに形成し、インターリードと電気的に接続する場合に、第2面131ABをインターリード側に凹んだ形状に形成した方がバンプ形成の際の許容誤差が大きくなる。図12に示すエッチング加工方法が知られる。図12に示すエッチング加工方法では、第1回目のエッチング工程までは、図11に示す方法と同じであるが、エッチング後第1180を第2回目の凹削1160側に延び込んだ後、第2回目の凹削1150側から第2回目のエッチングを行い、第2面を形成して行く。但し、第1回目のエッチングにて、第2面凹削1140からのエッチングを見分けて行く。図12に示すエッチング加工方法によって得られたリードフレームのインターリード先頭の断面形状は、図6(b)に示すように、第2面331ABがインターリード側にへこんだ凹削になる。

(0015) 尚、上記図11、図12に示すエッチング加工方法のように、エッチングを2段階にわけて行うエッチング加工方法を、一般に2段階エッチング加工方法というてあり、また加工に用いられる加工方法である。本例に用いた図9(a)に示す、リードフレーム130Aの加工においては、2段階エッチング加工で、第1段階は加工することにより部分的にリードフレーム厚を薄くしながら形成させる方法とが採用して行われており、リードフレーム厚を薄くした部分においては、特に、図9(a)に示すようにして、第1段階、図12に示す、上記の方法においては、インターリード先頭部131Aの両側部加工は、第2回目の凹削1160の基体と、最終的には行われるインターリード先頭部の厚さ1に定むられるので、例えば、厚さ50μm

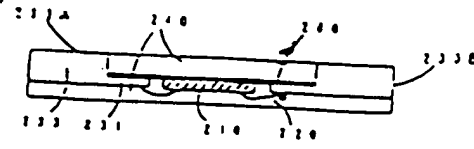
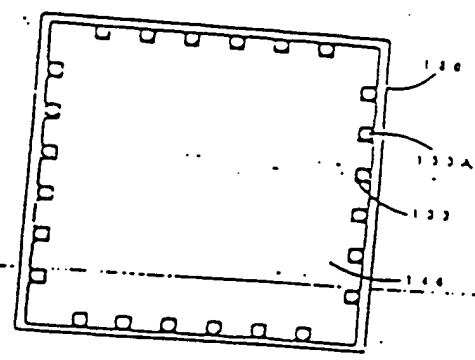
(0017) 本発明例1の半導体装置に用いられたリードフレームのインデニリッド部133Jの断面形状は、図13(イ) (a) に示すようになっており、ニッチング部133JAの側面W1には、半導体基板101の厚さW2より若干大きくなっており、W1、W2 (約100μm) と、この部分の厚さは方向別のW1よりも大きくなっている。このようにインナーリード先端部の断面に広がった断面形状であるため、どこに位置しても半導体基板(図示せず)とインナーリード先端部133JAとワイヤ1270A、1270Bによる接点(ボンディング)がしきい値ものとなっているが、本発明例の場合にはニッチング部133(O) (a) をボンディング部として用いる。また、図131Aはインデニリッド部133による平面、133JAはリードフレーム121A、121Bのつなぎ目である。ニッチング部133がフラットの無い面であるため、図13(O)の(a)の場合も、外に接点(ボンディング)値が得られる。図13(ハ)に図14に示す加工方法にて作成されたリードフレームのインナーリード先端部1331Bと半導体基板(図示せず)との接点(ボンディング)を示すものであるが、この場合もインナーリード先端部1331B

190		ードフレイム面	
260	1331A6	イニング面	
270	1410	ードフレイム面	
350	1420	オトレジスト	
470	1430	ジストパターン	
1110	1440	ンターリード	
ードフレイム面	1510	ードフレイム	
1120A, 1120B	1511	イパッド	
ジストパターン	1512	ンターリード	
1130	1512A	ンターリード先頭部	
一の面	1513	ウターリード	
1140	1514	ムバー	
二の面	1515	レーム部 (パッド)	
1150	1520	面表示	
一の面	1521	面 (パッド)	
1160	1530		
二の面	1540	止用面	
1170			
面			
1180			
ウチング面			
1320B, 1320C, 1320D			
イ			
1321B, 1321C, 1321D			
面			
1331B, 1331C, 1331D			
ンターリード先頭部			
1331A2			

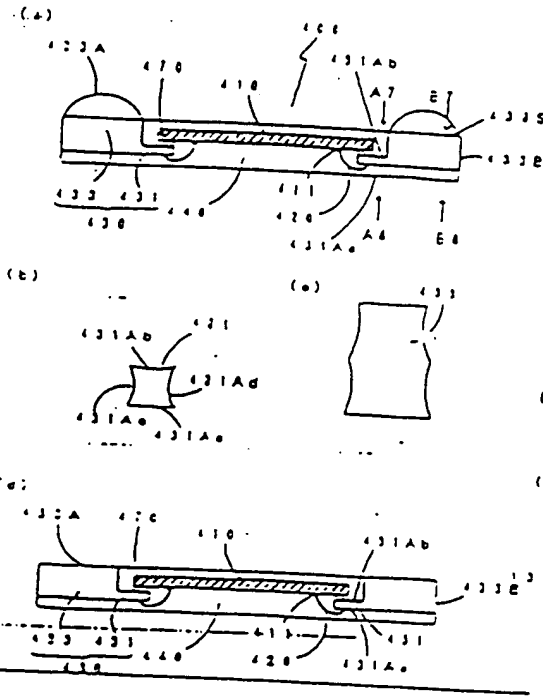
(2)



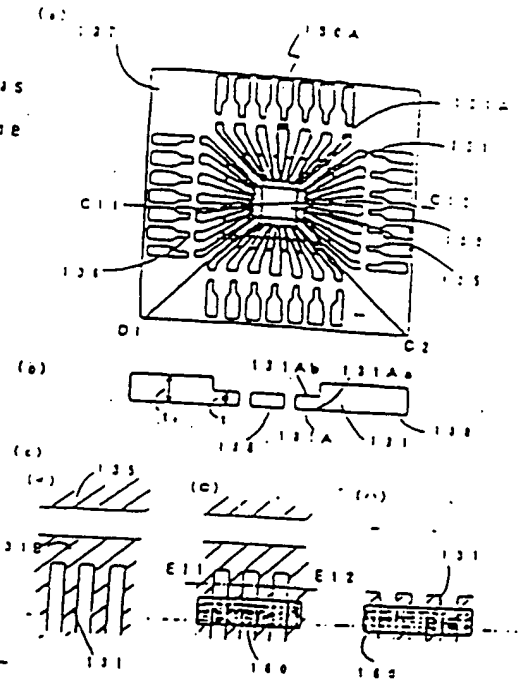
(4)



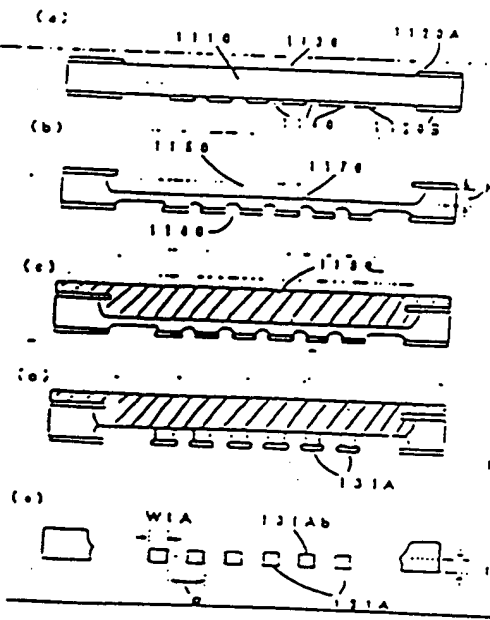
(27)



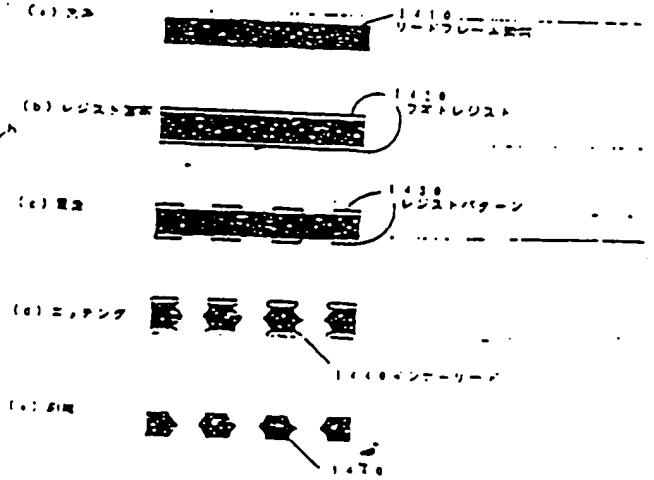
(29)



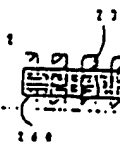
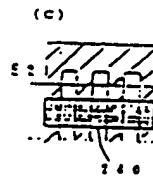
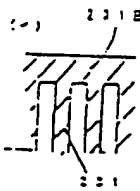
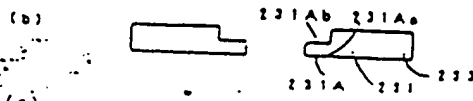
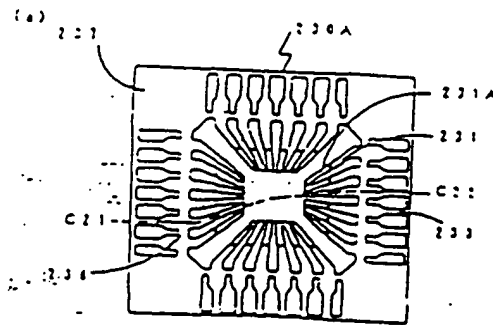
(31)



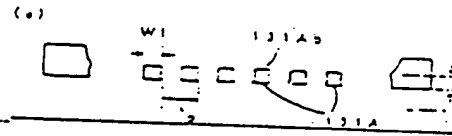
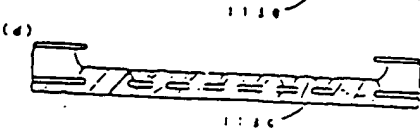
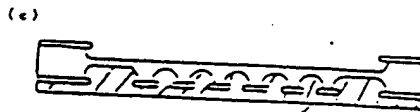
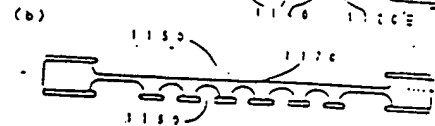
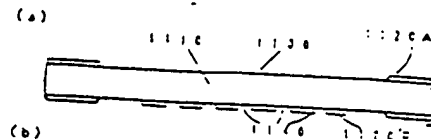
(34)



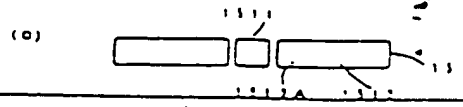
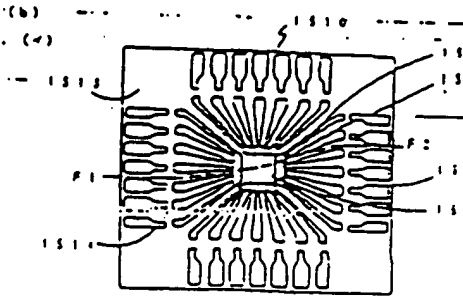
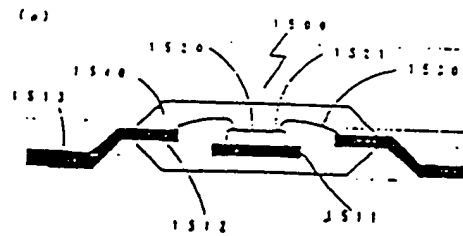
(5) (0)



(2:21)



! 5 !



(२ : ३)

